Revised AUGUST, 1965

EECO 751

FORMAT CONTROL BUFFER*

*U.S. Patent
No. 3,012,230

Electronic Engineering Company of California

EECO 751

The EECO 751 series of Format Control Buffers provide conversion buffering and format control to prepare blocked computer tapes from analog or asynchronous digital data.

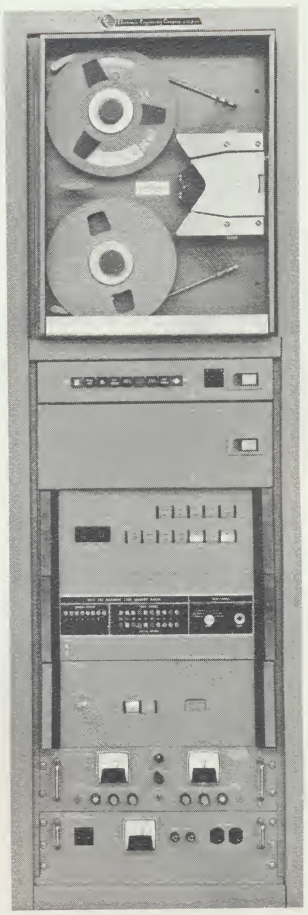
Input data can be from many sources, including:

- Analog data (By adding an A-D Converter)
- PDM to digital converters
- Digital recordings on magnetic tape
- Output from computers
- Digital data from transmission lines
- Shaft position encoders
- Optical readers
- Paper tape readers

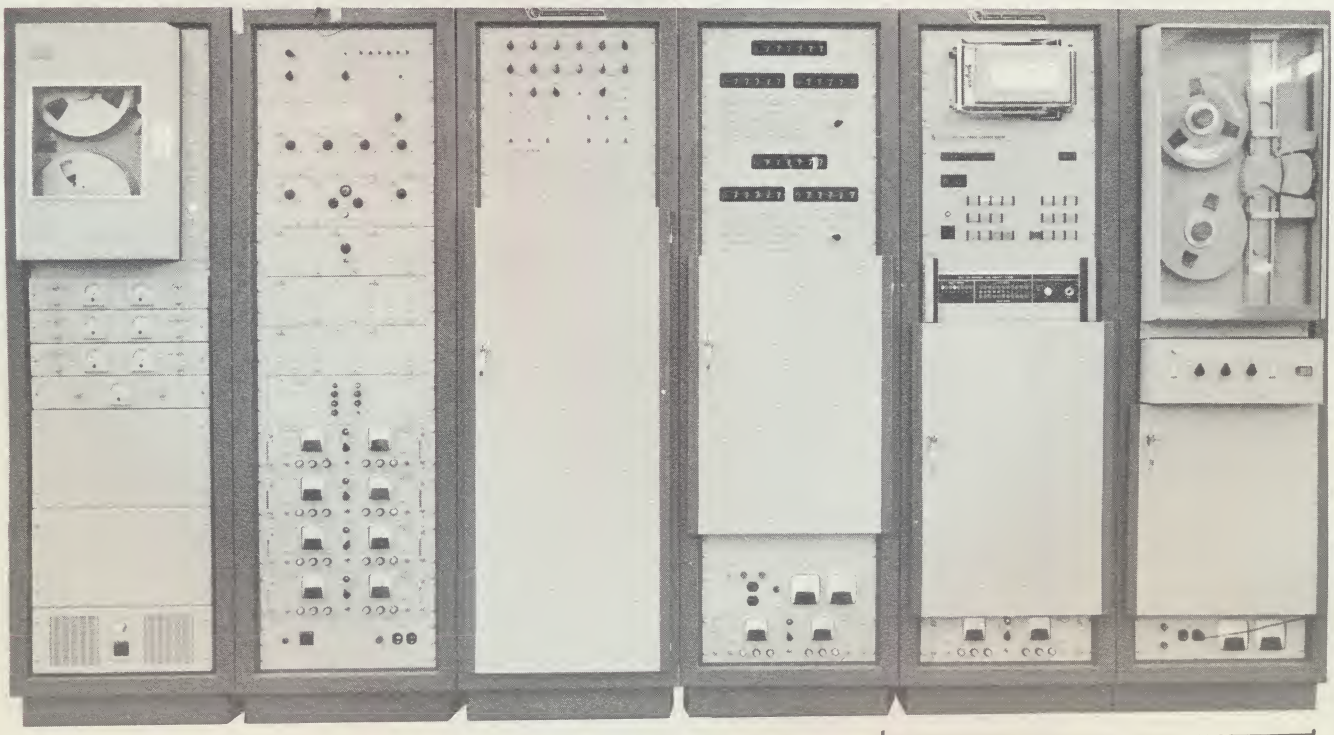
The output may be any computer format — although generally in standard IBM format at 200, 556, or 800 bpi. The data on the tape is in the exact format for use by a computer, with record gaps, parity bits, end-of-file gaps, etc. Models can be provided with the correct format and density for use with the IBM 360 series of computers.

Numerous options are available — most of which use standard EECO components or circuits.

The EECO 751 Buffers are ideally suited for reading a large amount of data at a high input rate. For example, data may be recorded at rates up to 70,000 data characters per second and a 2,400 foot reel of tape will contain approximately 20 million data characters at a 800 bits per inch density.

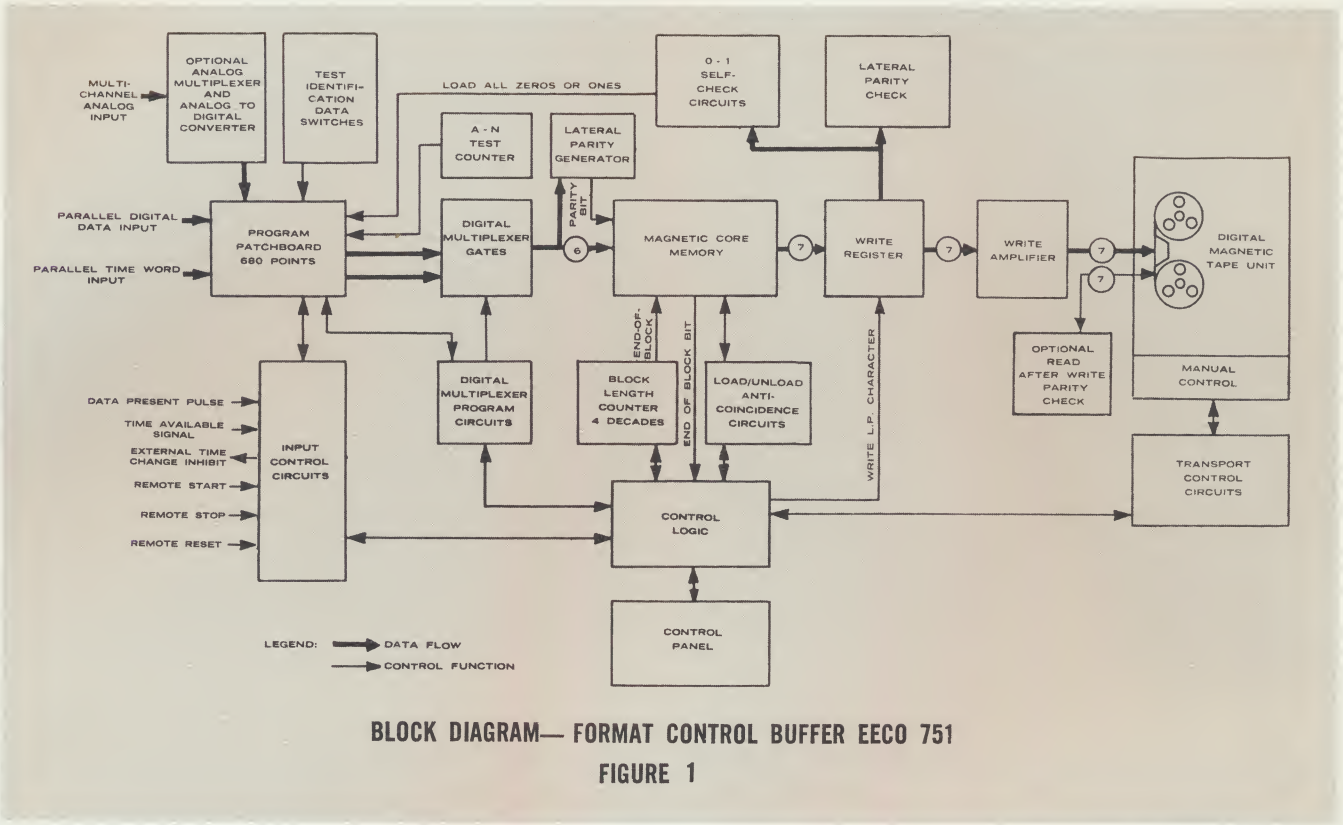


Single rack model of EECO 751-3.



EECO 751-1 used to generate computer tapes from radar data.

FORMAT CONTROL BUFFER



BLOCK DIAGRAM— FORMAT CONTROL BUFFER EECO 751

FIGURE 1

FUNCTIONAL DESCRIPTION

The basic data flow path through the buffer memory is shown in Figure 1 together with the error check and control circuits.

The parallel input data, the time, and the identification data words are fed to the program patchboard where bit positions and word lengths are determined. The input words are then routed to the digital multiplexer which derives a serial sequence of 6-bit characters from the parallel words.

The digital multiplexer is programmed by the patchboard for the number of 6-bit characters to be derived from the parallel input words. The number and order of the scanning signals to the multiplexer gates are also programmed by the patchboard. This results in a highly flexible, quick-change control for different input data formats and output block formats.

The 6-bit characters from the multiplexer are then stored in the core memory together with a seventh lateral parity bit generated for each character. Some bit positions may be blank when the data is BCD or when the number of bits in binary data words is not divisible by 6. When BCD digits are handled, the BCD zero (0000) may be converted to the IBM zero code (1010) before the memory load cycle.

When it is desired to enter test identification or time data into the output records, the digital multiplexer sequentially gates these characters into the memory during the time between input data samples. To accomplish this, the memory is loaded at its maximum rate in order to complete the identification and time reading before the arrival of the next data sample.

Input data is accumulated in the memory until the amount of data for one output tape block has been stored (as determined by the block length counter). The output tape is then started and after generation of the inter-record gap, data is recorded on the magnetic tape. The longitudinal parity gap and character are recorded at the end of each record.

All data characters unloaded from the memory are checked for proper lateral parity. An audible tone alarm and indicator light are used to indicate a parity error. A parity error may also halt the operation.

The memory continues to store input data during the output record cycle in models using a sequential interlace memory. In models with sequential memories without the interlace feature, the input is stopped during the write cycle.

INPUT DATA RATE

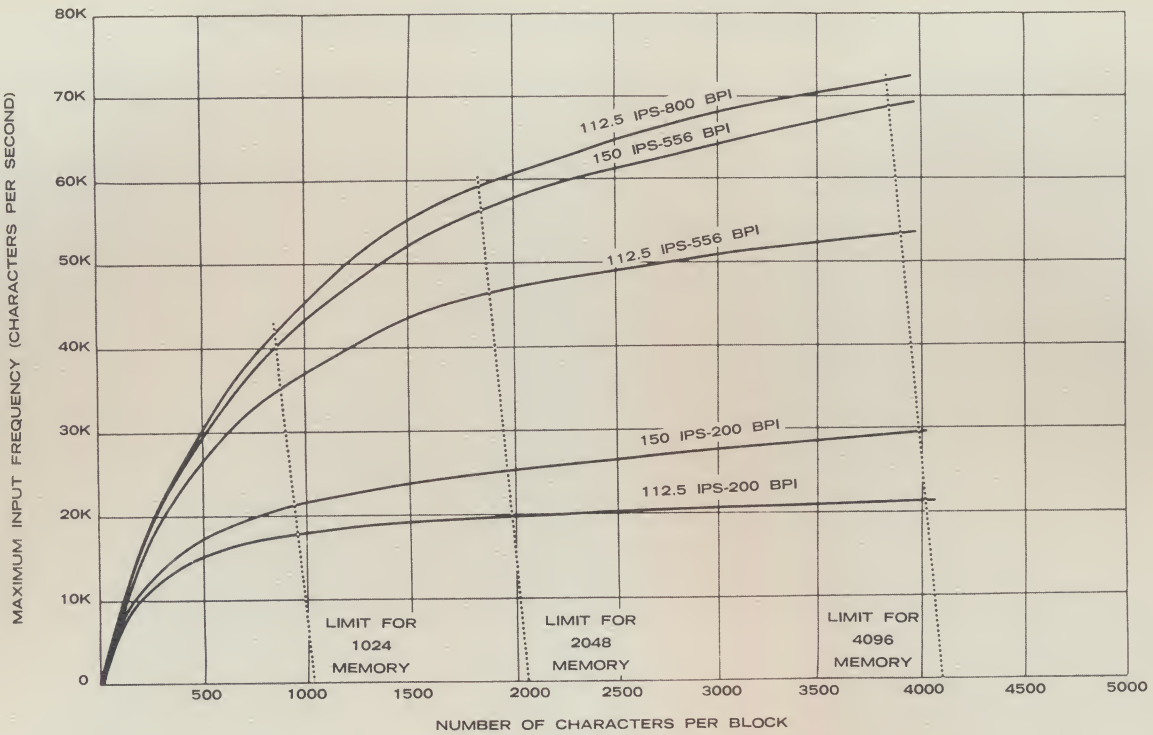


FIGURE 2. INPUT RATE VS. BLOCK LENGTH
for buffers using Sequential Interlace Memories

Since the EECO 751 output magnetic tape is recorded with ¾-inch inter-record gaps, the average input data character rate must always be less than the output recording rate. The maximum average input data rate to the FCB is dependent upon the following variables:

- Number of 6-bit characters derived from each data word
- Speed of output magnetic tape
- Recording density on output magnetic tape
- Start/stop characteristics of magnetic tape unit
- Number of characters in each output block
- Number of time or identification characters entered between data words
- Capacity of magnetic core memory

The maximum input rate (for models using sequential interlace memories) is determined from an input rate vs. block length graph as shown in Figure 2.

The curves in Figure 2 show input data rate capabilities of the EECO 751 for typical tape recorders, recording densities and block lengths when using a 1024-character, a 2048-character, and a 4096-character memory. The maximum average input rate is based upon 6-bit characters as stored in the buffer memory with an associated parity bit. In using this graph, all 6-bit characters derived from data, time, and identification words during one second should be added to obtain the average input rate.

Use of the graph is demonstrated by this example:

Assume a requirement exists to generate an IBM 7090 magnetic tape recording of a complex analog voltage of 300 cps fundamental frequency with significant components to the 5th harmonic. Accuracy of 0.1% is desired.

Since the input contains 1500 cps components, data will be sampled and digitized at a 15 kc rate by an EECO 760A ADC and a sample and hold aperture of 0.1 μsec. The desired accuracy requires 10 binary bits or 3 BCD digits. A 10-bit binary word will produce 2 IBM characters per sample, while the 3 BCD digits will produce 3 IBM characters resulting in character rates of 30 kc and 45 kc, respectively.

The graph shows that a tape speed of 112.5 ips with a recording density of 556 bits per inch will be adequate to record 30 kc and 45 kc character rates. The graph also shows that a 1024-character memory will suffice to record the 30 kc binary characters, while a 2048-character memory will be required to record the 45 kc BCD characters.

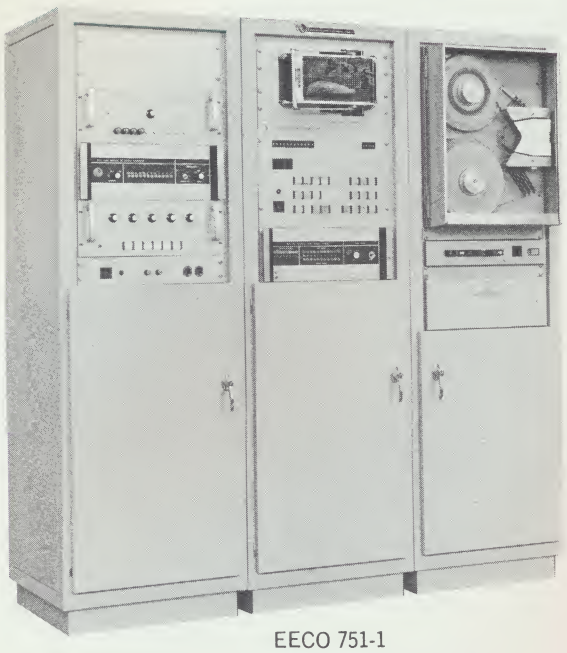
With the above binary input and a 1024-character memory, the graph shows that the output block can contain up to approximately 850 characters. If the block length is set to 500 characters, then 60 blocks will be recorded each second (30,000/500 = 60). With 12 digits (characters) of identification data and time recorded at the beginning of each block, then the total input character rate to the memory will be 30,000 plus 60 x 12, which equals 30,720 characters per second.

BLOCK LENGTH INFORMATION FOR SEQUENTIAL MEMORY SYSTEMS

The block lengths for units using sequential memories (EECO 751-4) can be equal to the memory capacity since the input cycle is stopped during the complete write cycle. The maximum input rate is determined by the cycle time of the memory. Memories generally permit input rates of 200 kc; but, if required, faster memories can be supplied which will accept data at rates considerably above 200 kc.

MODEL VARIATIONS

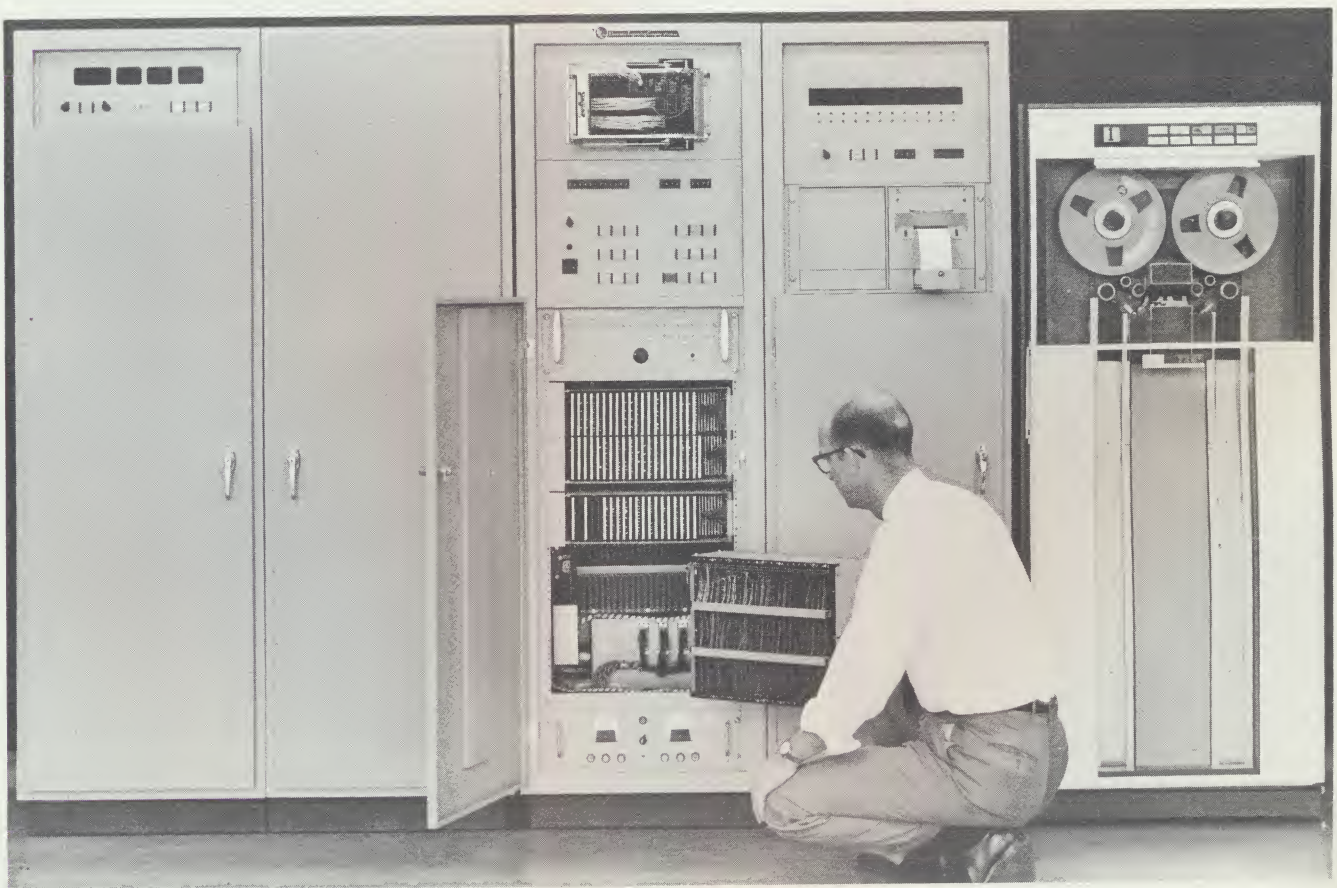
The principal variations in four of the EECO 751 models are listed below:



EECO 751-1
with A-D converter and multiplexer.

Summary of specification variations of EECO 751 Format Control Buffers

	EECO 751-1	EECO 751-2	EECO 751-3	EECO 751-4
General	36-bit input word length	Same as 751-1 but uses IBM 729 Tape Unit	12-bit input word length. No provision for Time or I.D. word	6-bit input word length. Sequential memory which limits speed
Max. average data input rate (for 6-bit input characters, 556 bpi 4096 memory and a tape speed of 150 ips.	65 KC at 3,800 characters per block	Same	Same	200 KC or faster
Data input form	36-bit parallel data word	Same	12-bit parallel data word (2 tape characters for binary data —3 tape characters for BCD data)	6-bit parallel data word
Identification data (Front panel thumbwheel switches)	12 decimal digits (48-bit parallel word)	Same	None	None
Time word input	48-bit parallel time word	Same	None	None
Memory type	Sequential interlace. Data recorded on tape without interrupting input.	Same	Same	Sequential memory. Input interrupted during write cycle.
Block length	90 to 95% of memory length	Same	Same	Equal to memory length
Test features	Built-in alpha-numeric test counter	Same	None	None
	Built-in 0-1 test program	Same	None	None
Format control	Patch programmed	Same	fixed wired	Same



EECO 751-2 with special input circuits and special read after write check circuits and check printer.

INPUT SPECIFICATIONS

Analog Data

Single channel or multiple channel inputs at either high or low levels can be accepted by adding EECO multiplexers and A-D Converters.

Digital Data

Data words may be in parallel or serial form. Standard word lengths are up to 36 bits.

Input levels:
Binary "1" — 0 ± .25 volts
Binary "0" — −10 ± 2 volts

Time Word

Up to 48-bit parallel word representing days, hours, minutes, seconds, and milliseconds. Time may be entered at the beginning of each record.

Identification Word

Thumbwheel switches can be provided to enter up to 12 decimal numbers for identification purposes. The FCB can be programmed to enter these numbers as a separate header record or at the start of each data record.

Remote Control

Inputs for remote commands for "Start", "Stop", and "Reset" can be provided.

OUTPUTS

Output magnetic tapes can be prepared for virtually any computer, including the IBM 360 series.

The data in this section applies to IBM format for use with IBM 1401, 7090 and others in this series.

Tape Format

Fig. 3 shows a typical IBM format. Recording is in IBM NRZ form.

Density

200, 556, or 800 bits per inch. Any two are standard. All three can be supplied as an option.

Block Length

Selectable by front panel thumbwheel switches — depends on memory size, tape speed, input speed, etc. Fig. 2 shows the block length limits for various conditions.

Lateral Parity

Selectable — either even or odd.

Coding

Either binary or BCD.

Output Character Order

Patchable within word.

Longitudinal Parity

Automatically recorded after each block and after end-of-file mark.

Record Gap

Standard ¾" gap automatically recorded after each block or record.

End-of-File

Standard 3¾" end-of-file gap, tape mark and longitudinal parity character recorded automatically or on manual command.

Load Point

Tape advances to proper distance past reflective load point on manual command. Recording starts at this point.

End-of-Tape Mark

Recording is stopped automatically at reflective end-of-tape mark. Any incomplete block or record is completed before the stop occurs.

Stop Routine

If a stop command occurs within a block, the block in process will be filled with blank characters.

Identification Block Formats

Although identification and/or time words may be recorded at the beginning of each data block, these may be recorded as a separate header block to maintain maximum input data rate. Any of the header block formats listed below may be set up on the FCB.

a. Up to 12 digits of identification data recycled continuously until preset block length is reached.
b. Several sets (block length is limit) of 12 digits. Settings of identification data switches can be changed after each group is stored.
c. Up to 12 digits of identification data followed by up to 12 digits of time. Block length set equal to number of identification and time digits.

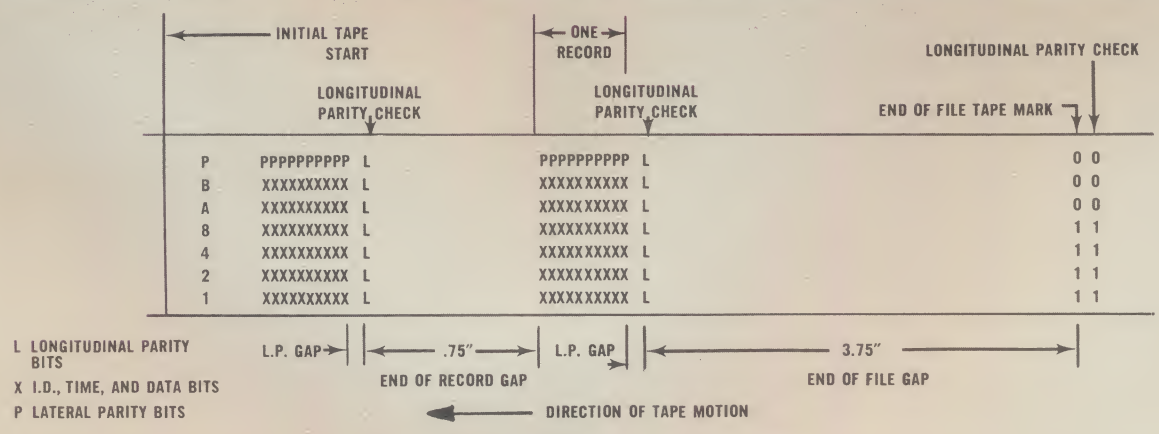
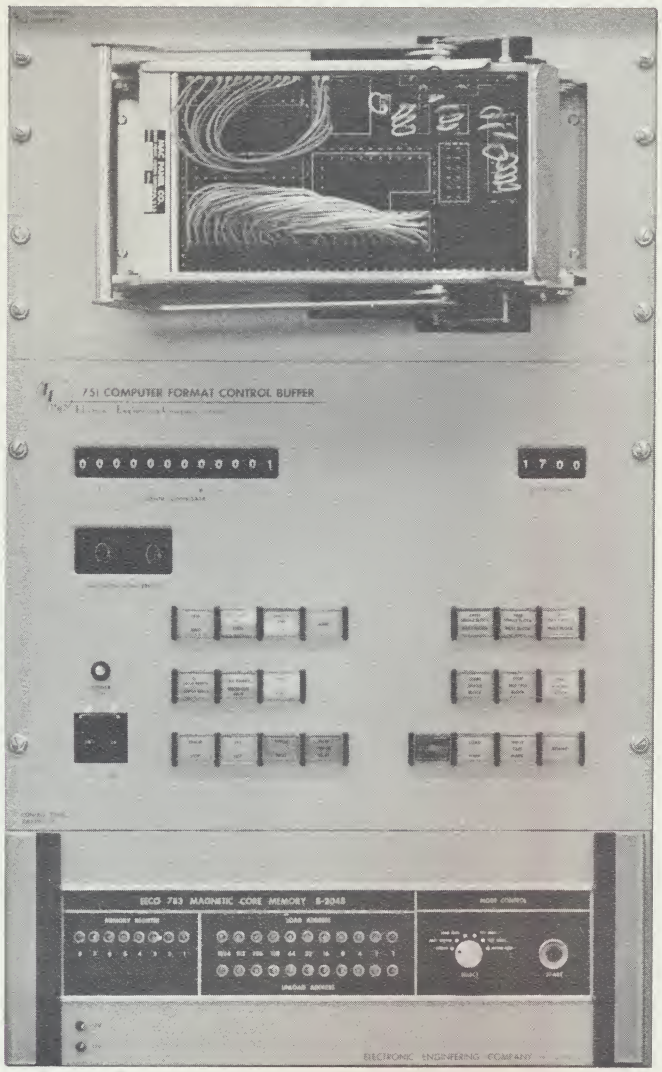


FIGURE 3 — TYPICAL IBM TAPE OUTPUT FORMAT

CONTROLS AND INDICATORS



Controls on EECO 751-1.

BUFFER CONTROLS

PUSHBUTTONS

Certain key Buffer pushbutton controls have built-in lights to show active status.

- MASTER RESET
- LOAD POINT
- WRITE TAPE MARK (END-OF-FILE)*
- REWIND TAPE*
- IBM ZERO CONVERT
- IBM HIGH/LOW DENSITY
- LATERAL PARITY ODD/EVEN
- TEST I.D. SINGLE/MULTIPLE BLOCK
- TIME WORD SINGLE/MULTIPLE BLOCK
- INPUT DATA SINGLE/MULTIPLE BLOCK
- START — SINGLE BLOCK
- START — MULTIPLE BLOCK
- STOP — MULTIPLE BLOCK
- ERROR STOP
- ERROR RESET
- 0-1 SELF-TEST

THUMBWHEEL SWITCHES

- IDENTIFICATION DATA (12 SWITCHES)
- BLOCK LENGTH (4 SWITCHES)

680 POINT PROGRAM PATCHBOARD
MAIN POWER CIRCUIT BREAKER SWITCH, ON-OFF

*Note: May be programmed on pre-wired patchboard, status indicators on pushbuttons remain active.

BUFFER INDICATORS

- 0-1 INPUT ERROR
- 0-1 OUTPUT ERROR
- LATERAL PARITY ERROR
- EXCESSIVE INPUT RATE ERROR
- TAPE UNIT READY
- AC POWER ON

MEMORY CONTROLS AND INDICATORS

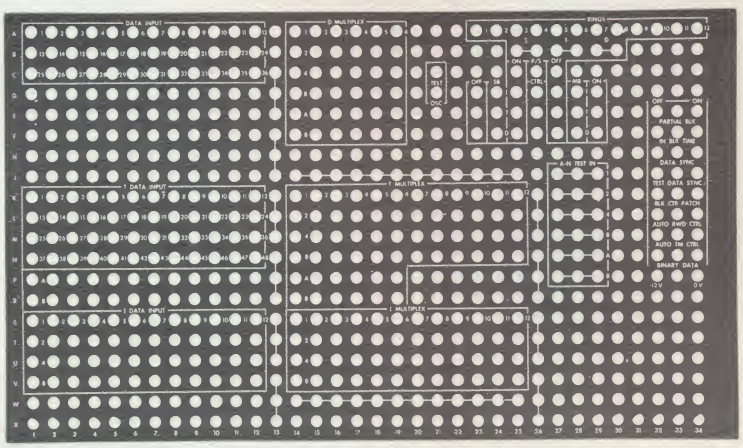
- MODE CONTROL SELECT SWITCH: OPERATE, MASTER RESET, TEST ZERO'S, LOAD ONE'S, TEST ONE'S, MAN. UNLOAD
- MODE CONTROL START PUSHBUTTON
- MEMORY REGISTER: 8 BINARY INDICATORS
- LOAD ADDRESS: 10 BINARY INDICATORS (FOR 1024 MEMORY)
- UNLOAD ADDRESS: 10 BINARY INDICATORS (FOR 1024 MEMORY)

TAPE UNIT CONTROLS AND INDICATORS

Standard controls and indicators on tape unit manual control panel as supplied by tape unit manufacturer.

POWER SOURCE

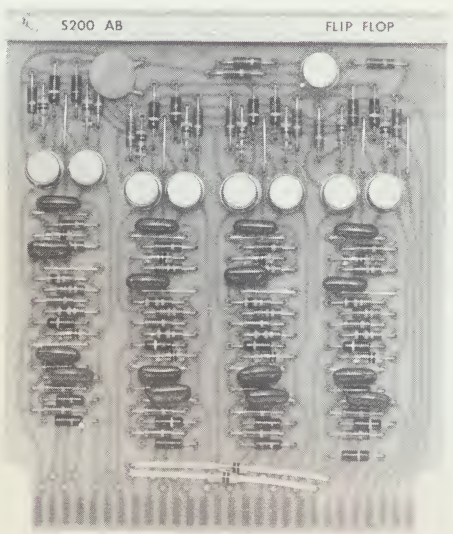
117 VAC ± 10%, 60 cps ± 1 cycle, single phase 15 amp maximum using typical magnetic tape unit. All EECO power supplies operate with 50 to 400 cycle input.



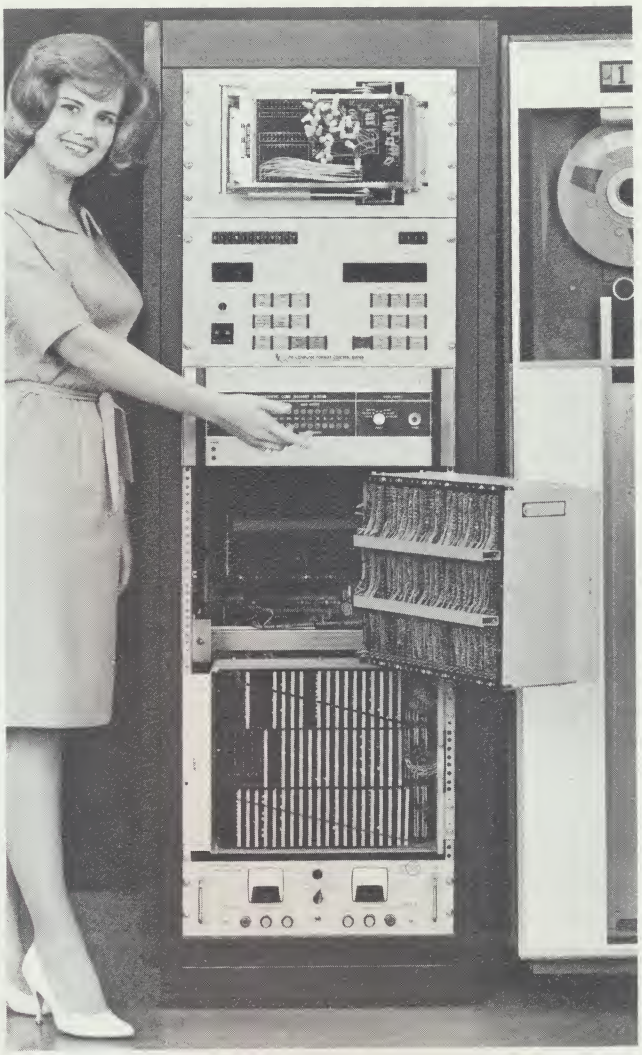
680 POINT PROGRAM PATCHBOARD

OPTIONAL FEATURES

1. **Analog Inputs**
   Analog inputs can be accepted by using any of several combinations of analog multiplexers and analog to digital converters. From 1 to 200 inputs can be accommodated with levels down to a few millivolts.
2. **Single or Multiple Density**
   The standard EECO 751 produces any two of the following IBM densities:
   200, 556 and 800 BPI
   The third density can be added as an option.
3. **Memory Size**
   256, 512, 1024, 2048 and 4096 character capacity and levels of 9 or more can be provided.
4. **Tape Units**
   The type of output tape unit is optional and will depend upon data speed, output format requirements and customer preferences. Most digital magnetic tape units may be used with the FCB. A partial list of suggested tape units are:
   Potter 906II, MT-120, MT-36
   IBM 729II, 729 IV, 729 V, 729 VI, 7330, 2400, 7340 Hypertape
   CDC 603, 604, 606, 607
   Ampex TM-2, TM-3, TM-4, TM-5
   Datamec D-2020
   Burroughs BC-422
   CEC DR 2700
   Cook Model 59
   NCR C-334
5. **Read-After-Write Check**
   A read-after-write parity check circuit is available with or without a parity error counter which counts and displays detected errors.
6. **Input Level Shifters**
   Special input level shifters are available for any range of input voltage levels.
7. **Frame Counter**
   A frame counter may be included to block telemetry data on a preset number of frames.
8. **Block Counter**
   This circuit counts and displays the total number of output blocks generated.
9. **Optional Output Formats**
   Output formats may be provided for computers of these and other manufacturers (in addition to IBM):
   - Remington Rand
   - Radio Corporation of America
   - General Electric
   - Bendix
   - National Cash Register
   - Minneapolis-Honeywell
   - Philco
   - Burroughs



EECO plug-in printed circuit card



EECO 751-2 showing swing out construction.

PHYSICAL SPECIFICATIONS

Dimensions
Approximately 6 feet high, 4 feet wide, 2 feet deep. Two EECO electronic equipment racks bolted together.

Weight
Approximately 1,800 pounds

Circuit Modules
EECO plug-in printed circuit cards using solid-state components. Operation temperature range of circuit cards −20°C to +65°C.

Chassis Construction
Swing-out circuit card gate assemblies used where possible. Some system components use standard panel-chassis construction with pull-out and tilt-up chassis slides. Access is provided to all pin connections from front or rear of equipment racks.

Spare Space
Space is available in the unit for various optional features and auxiliary system components such as an analog-to-digital converter and analog multiplexer.

Finish
May be specified. If not specified, will be EECO gray (Fed. Std. 595-26231) with panels finished semi-gloss and racks vinyl textured.

Environmental Specifications
Ambient temperature 50°F to 122°F depending upon specific magnetic tape unit used. A small blower is provided in each equipment rack with dust filter in rear door. Relative humidity 20% to 90%.

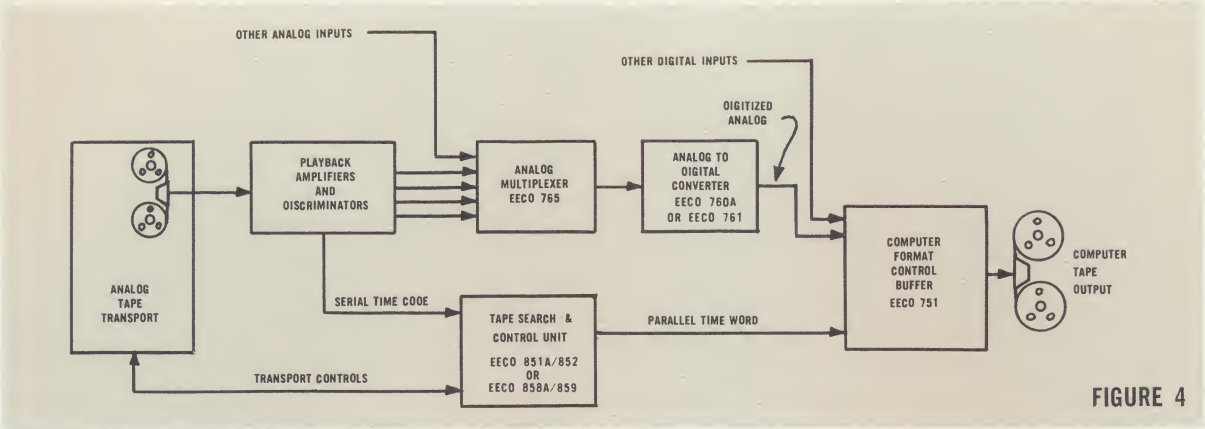


FIGURE 4

ANALOG TO DIGITAL DATA CONVERSION SYSTEM

The system shown in Figure 4 is typical of ADC systems used to convert direct analog, FM/FM and PAM/FM/FM tapes to computer tapes. This system:

- Locates desired time correlated data automatically
- Digitizes multichannel analog data
- Records data and time in computer tape format

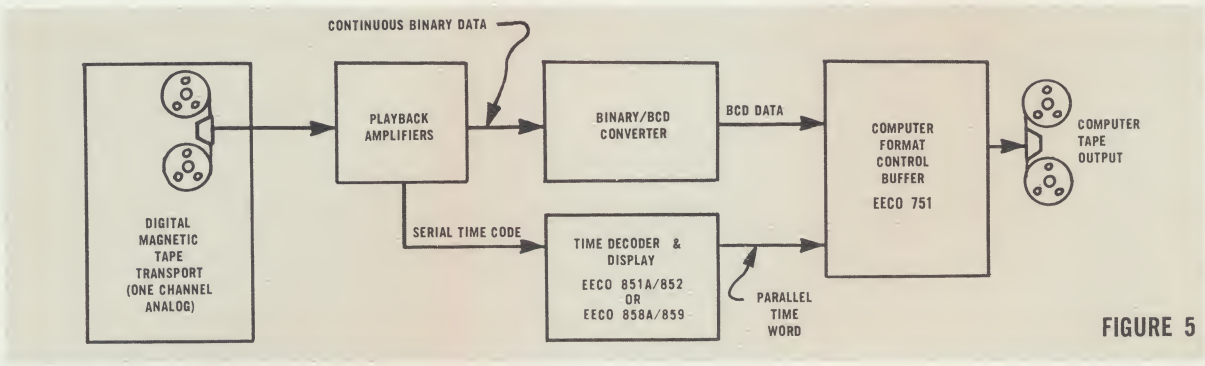


FIGURE 5

DIGITAL DATA BUFFER SYSTEM

Figure 5 shows a typical Digital Data Buffer System for converting IRIG PCM digital tapes and other "non-formatted" digital tapes to computer tape format. The system is shown with an optional Binary-to-BCD Converter. Serial time is decoded on a manual tape search unit. This system:

- Locates desired time-correlated data by manual control
- Converts continuous binary data to BCD code
- Records BCD data and time in computer tape format

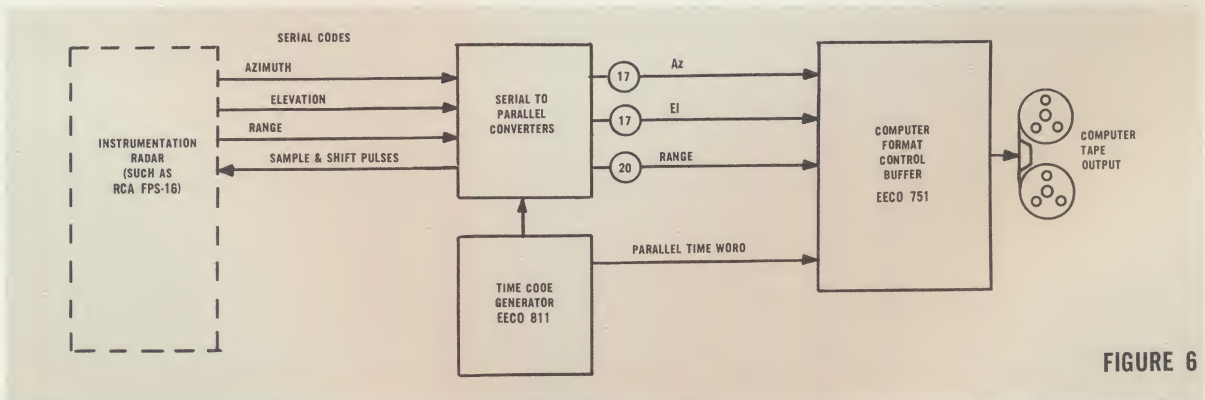


FIGURE 6

RADAR DATA CONVERSION SYSTEM

The system shown in Figure 6 is typical of Radar Data Conversion Systems used for conversion and real-time recording of space position data in computer tape format. This type of system may be expanded to include components such as Gray-to-Binary Converters, Binary-to-BCD Converters and Decimal Display Units. The EECO 751 may also include the playback option to reproduce a continuous digital output for input to high-speed data transmission systems. This system:

- Samples radar with precision timing signals
- Provides gray-to-binary shift pulses to radar
- Converts serial binary words to parallel form
- Records radar data and time in computer tape format

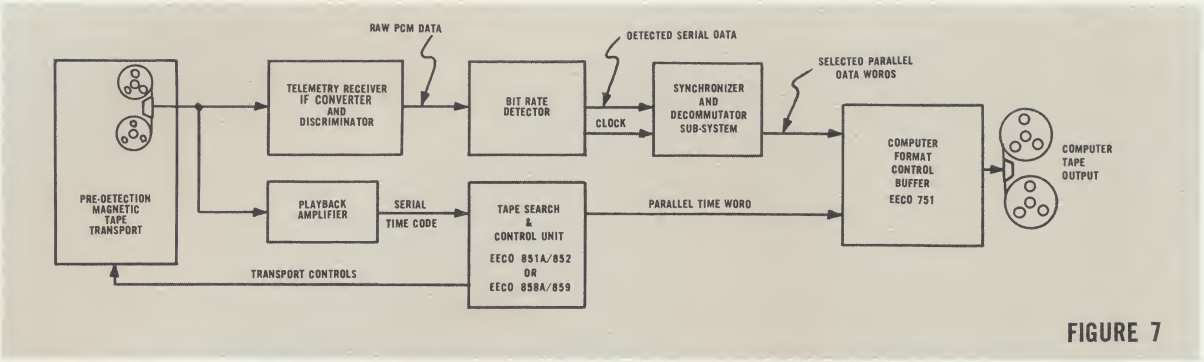


FIGURE 7

PCM DATA REDUCTION SYSTEM

A typical system used to reduce PCM data to computer tape is shown in Figure 7. Input to the system is from a predetection recorded magnetic tape. By adding telemetry receiver RF and IF amplifiers and a Time Code Generator this system may record PCM data in real time, either predetection recording or computer format recording or both. An EECO 147 Binary/BCD Converter may be added when IBM BCD format is desired. This system:

- **Locates desired time correlated data automatically**
- **Detects raw PCM data from predetection recording**
- **Derives bit clock and reconstitutes serial data**
- **Derives word and frame synchronization and decommunicates selected data**
- **Records data and time in computer tape format**

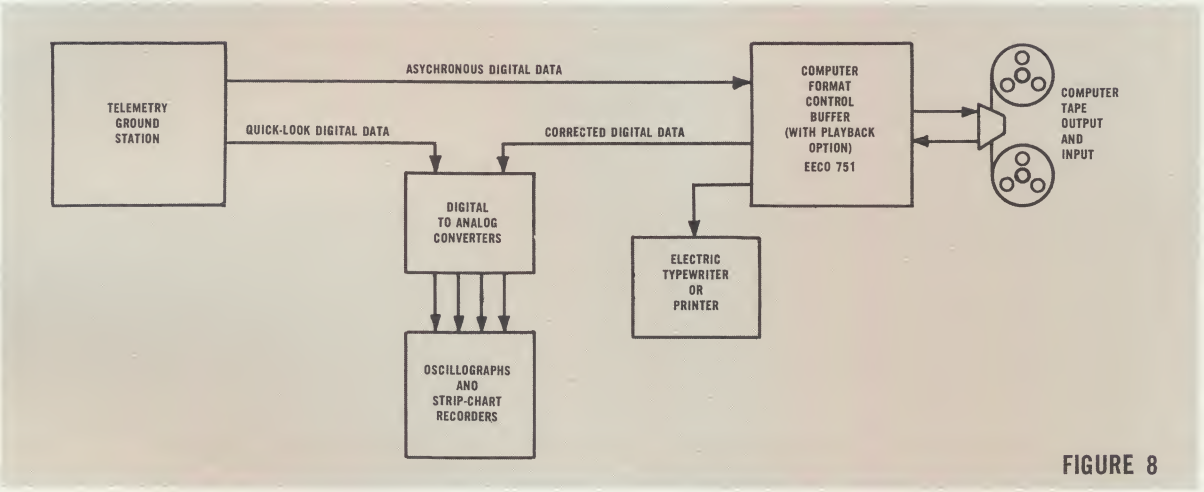
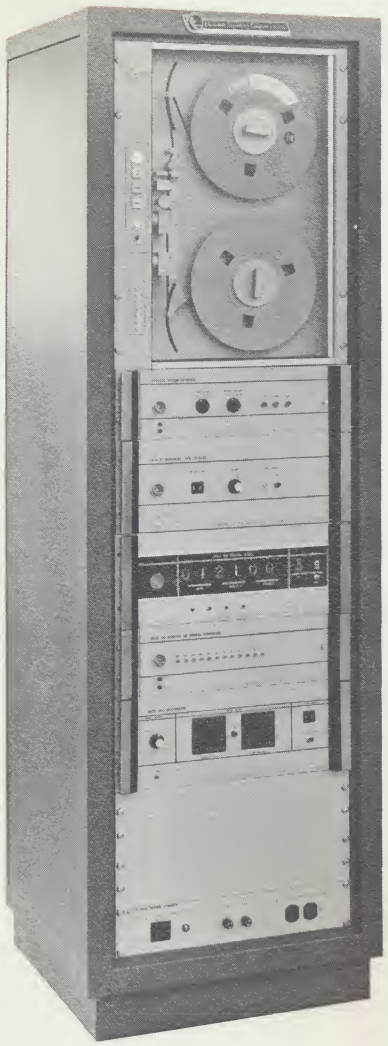


FIGURE 8

TELEMETRY DATA HANDLING SYSTEMS

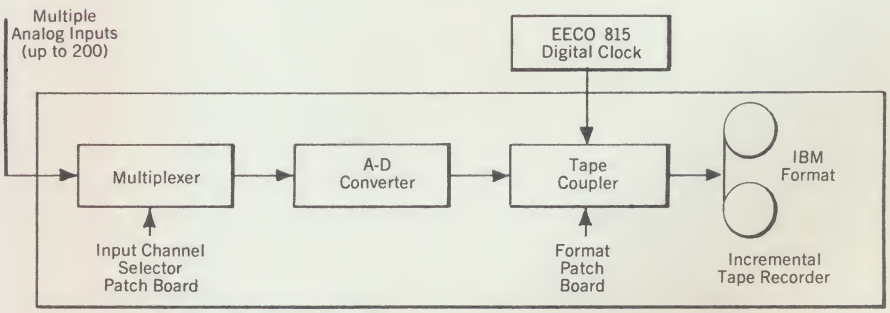
Figure 8 shows a typical application of the EECO 751 including the playback option. This system:

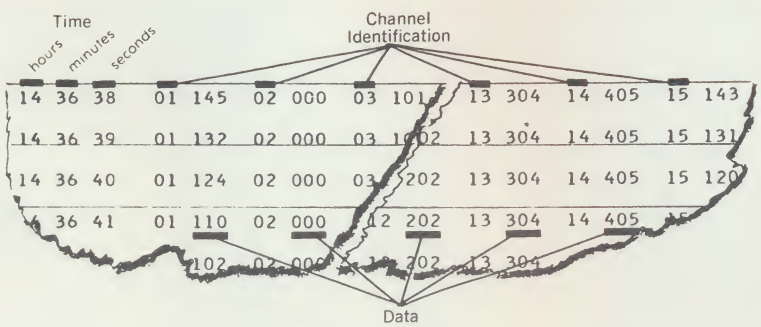
- **Records data in computer tape format**
- **Provides quick-look recording of raw data**
- **Reproduces data corrected for scaling, linearization and offset for direct recording**
- **Produces printout of selected data or computer tape**



EECO 755
DATA RECORDING SYSTEM
IBM Format — Incremental Tape Unit

- Digitizes up to 200 analog inputs and records on magnetic tape in IBM format.
- Economical — no buffer memory — same price range as slower recording systems.
- 500 tape characters per second — equivalent to 250 2-decimal or 2-binary-character or 166 3-decimal measurements and recordings per second.
- All solid state — no mechanical switches — no relays — no stepping switch in either the multiplexer or the A-D Converter.
- ±.05% accuracy (3 decimal digits plus sign) for ±5 volts input.
- Continuous scanning or scanning at intervals on command from internal clock or from external equipment.
- 100 megohm input impedance.
- Gated display of selected digitized channel.
- Record length selectable — 1 to 100 scans.

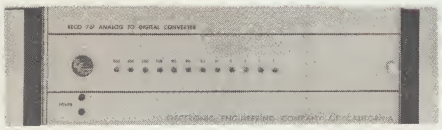




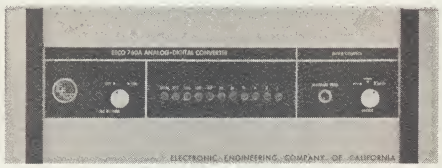
Printout of recorded data

Portion of typical printout of 15 channels of data — made by IBM 1401 computer. (Spaces inserted in computer program.) Data scanned once each second (single scan operation). Time for scan is approximately 160 milliseconds.

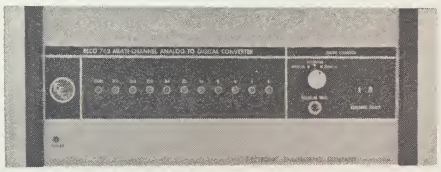
EECO DATA SYSTEM COMPONENTS



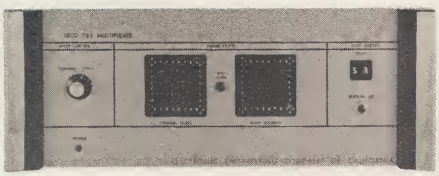
EECO 761 Analog to Digital Converter.
Up to 11 bits binary or 3 BCD digits at conversion speeds of 12,000 per second.



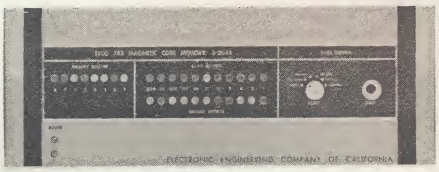
EECO 760A Analog to Digital Converter.
Up to 14 bits binary or 4 BCD digits and sign at conversion speeds of 33,000 per second.



EECO 762 Multi-Channel ADC.
Up to 100 analog channels input and 4 decimal digits output in a single chassis.



EECO 765 Analog Multiplexer.
Up to 100 channels. ±50 millivolt to ±5 volt input. 100 megohm closed input impedance. Patchboard sequencing.



EECO 781, 782, 783 Magnetic Core Memories
Random, Sequential or Sequential Interlace. 5 μsecond cycle time. Self-check with visual indicators.

Electronic Engineering Company
of California

HOME OFFICE:
1601 E. Chestnut Avenue, P.O. Box 58
Santa Ana, California 92702
Phone: (714) 547-5501

WASHINGTON D.C. OFFICE:
Room 403, 1801 No. Moore Street
Arlington, Virginia 22209
Phone: (703) 525-2700

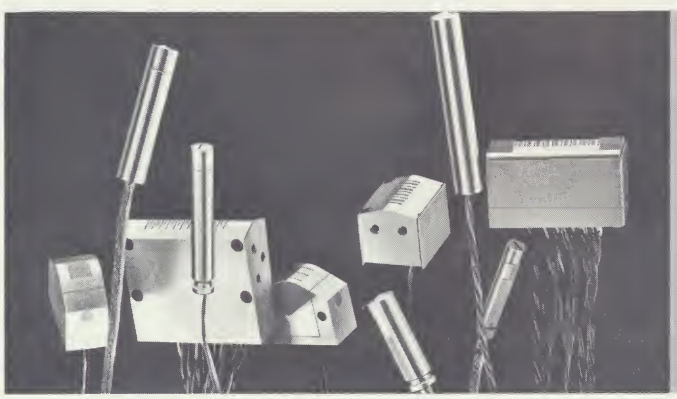
SPECIFICATIONS

DBW SERIES TRACKS PER ½ INCH		3	4	5	6	7	8	9	10
TRACK WIDTH MAXIMUM INCHES	WRITE	.125	.090	.070	.060	.048	.042	.032	.026
	READ	.100	.074	.054	.044	.032	.026	.020	.018
INDUCTANCE MAXIMUM — MILLIHENRIES	READ	500	400	300	200	150	100	90	80
CROSS TALK MAXIMUM — db	READ TO READ	—70	—60	—55	—50	—45	—43	—42	—41
CROSS TALK MAXIMUM — db	WRITE TO READ .390 GAP TO GAP	—50	—50	—50	—50	—50	—50	—50	—50
READ TO WRITE GAP SPACING		.150 INCHES MINIMUM							
GAP LENGTH		20 MICROINCHES MINIMUM							
RADIUS		.125 INCHES MINIMUM RECOMMENDED FOR REASONABLE HEAD WEAR							
GAP SCATTER		±50 MICROINCHES — STANDARD ±25 MICROINCHES — AVAILABLE							
AZIMUTH		±1 MINUTE — STANDARD ±⅓ MINUTE — AVAILABLE							
PARALLELISM READ TO WRITE GAP		100 MICROINCHES PER INCH							
MOUNTING		ANY							

DBW SERIES DIGITAL MAGNETIC TAPE HEADS

Magne-Head is an industry leader in the design and manufacture of magnetic heads for all types of commercial and military applications. Continuing research enables Magne-Head to offer ideas and improvements in both performance standards and packaging design. Our engineers are available to work with you on any magnetic head problem—large or small—from prototype to production. Magne-Head has demonstrated capabilities in design and production for such applications as a satellite-borne telemetry tape recorder, 56-channel in line read-after-write head for magnetic card random access computer memory, shipboard tactical data processing systems, aircraft audio pilot warning device, tape memory for stock exchange quotation device, and heads to operate in radioactive environments.

FOR THE FULL STORY: write or call Magne-Head—area code 213—772-2351/TWX 910-325-6203



- *DRUM*
- *DISC*
- *DIGITAL TAPE*
- *ANALOG TAPE*
- *CHARACTER RECOGNITION*
- *MAGNETIC CARDS*

Printed in U.S.A. 2M 10/63